



## Materials Engineering Branch

### TIP\*



#### No. 130 Determination of Fiber Volume in Graphite Epoxy Composites Using Computer Imaging

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Determining fiber content in graphite/epoxy (GR/EP) materials is essential to accurately predicting the thermal expansion of structural members. The traditional technique used to determine fiber volume is by means of acid digestion. This technique requires that the cured graphite/epoxy material first be dissolved in boiling nitric acid and then washed in acetone. The environmental impact of the acid digestion technique is twofold. The fumes generated during digestion may not be completely captured in the condenser and the acid digestion technique produces over 200 milliliters of waste chemicals for each gram of acid digestion specimen.

Optical examination is an alternate way to evaluate the fiber volume. Test specimens are mounted and polished using standard metallographic techniques. The limitation of optical techniques has been that the imaging programs were available only on large computers, or that the laboratory techniques available were tedious and required extensive operator involvement. The recent improvements in both personal computers and imaging software and hardware have made the use of imaging techniques to evaluate fiber content in graphite/epoxy materials a viable alternative to acid digestion.

The Materials Engineering Branch (Code 541) has recently demonstrated that the optical examination of (GR/EP) materials using imaging software can accurately determine fiber volume in a timely fashion. The imaging technique also determines void content and laminate ply orientation.

This technique is described in detail in MIL-HDBK-17/1, Section 6.6.6.5, "Composite Materials Handbook Volume1: Polymer Matrix Components Guidelines for Characterization of Structural Materials.